A PICTURE BOOK OF INSECTS

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WHEREVER YOU MAY GO—TO THE ORCHARD, MEADOW OR FOREST—YOU'LL FIND YOURSELF SURROUNDED BY INSECTS. YOU MAY SEE A BEETLE CRAWLING IN THE GRASS AND BEES AND BUTTERFLIES HOVERING OVER THE FLOWERS, AND HEAR THE CHIRRING OF GRASSHOPPERS AND THE RUSTLING OF DRAGONFLY WINGS. COMING UP TO A STREAM YOU'LL DISCOVER INSECTS THERE TOO. SHOALS OF GLITTERING WHIRLIGIG BEETLES RUSH ABOUT THE SURFACE WHILE UNDER IT BACK SWIMMERS AND DIVING BEETLES, THEIR LEGS ROWING LIKE OARS, HUNT FOR SMALLER WATER CREATURES.

WHAT AN EMPTY PLACE THE DESERT SEEMS TO BE—NOTHING BUT SAND ALL AROUND AND WILTED BUSHES THAT GIVE NO SHADE. ON CLOSER LOOK, HOWEVER, YOU WILL SEE INSECTS SITTING ON THE BUSHES—A DESERT ACRIDIAN CHEWING A LEAF, BUPRESTID BEETLES, THEIR SHELLS AS HARD AS NUTS, RESTING ON THE BRANCHES, AND DRY BLADES OF GRASS WHICH LOOK LIKE FLOWERS FROM A DISTANCE. THIS IS BECAUSE HANGING FROM THE BLADE TOPS ARE BRIGHTLY COLOURED BLISTER BEETLES CALLED SO FOR THEIR POISONOUS BLOOD.

IF AT NIGHT YOU LIGHT A BRIGHT LANTERN ON A SAND HILL, MOTHS, ICHNEUMON FLIES AND BEETLES WILL IMMEDIATELY APPEAR IN SWARMS AND YOU WILL WONDER WHERE THEY ALL HAD BEEN HIDING DURING THE DAY. IN THE MORNING FINE TRAILS ARE LEFT ON THE SAND—THE FOOTPRINTS OF DARKLING BEETLES WHICH WERE CALLING ON EACH OTHER DURING THE NIGHT.

INSECTS ALSO LIVE IN CAVES WHERE IT IS ALWAYS DARK, HIGH UP IN THE MOUNTAINS, AND IN SNOW-COVERED FIELDS AND ON GLACIERS.

AND WHAT ABOUT THE OCEAN? SURELY NO INSECTS ARE FOUND THERE? GIANT MOUNTAINS OF WATER CRASHING AGAINST EACH OTHER DURING A STORM WOULD CRUSH THE LITTLE CREATURES AT ONCE. HOWEVER, AS SOON AS THE SEA SETTLES DOWN YOU WILL SEE WATER BEETLES GLIDING ON ITS SURFACE. HOW DO THEY MANAGE TO SURVIVE THE STORM? WHEN AN ONCOMING WAVE IS ABOUT TO CRASH DOWN, THE CLEVER WATER BEETLES DIVE UNDER IT AND ESCAPE THE DANGER.

SO WHEREVER YOU LOOK, YOU WILL NOTICE INSECTS, OUR SMALL INCONSPICUOUS NEIGHBOURS.

Are insects really so inconspicuous?

Here is what sometimes happens in southern lands. Warm spring rains end and mountain slopes, usually dry and brown, turn green. After a short while legions of acridians the size of ants appear from somewhere. At first they are too small to be noticed, but they grow and in a week or two the grass is swarming with them. Then the grass disappears because it has been eaten up. The acridians continue to grow and they want more food. So they come down from the mountain slopes to river banks, groves, orchards, and cultivated areas. By that time the insects are much larger and have wings. They are no longer acridians but locusts. They first travel singly, then in groups, which grow larger and larger until there are swarms of them. In several days what used to be a blooming valley is dreary, lifeless land because the locusts have stripped it of all vegetation.

Then the locusts take wing and fly like a huge cloud covering the sun. Sometimes these clouds are as large as a big city. When they come down on orchards, tree branches creak under the weight of the insects and no other sound can be heard except the strange and monotonous crunch that the locusts make when moving their jaws. Such an invasion is a terrible disaster because it brings famine.

You do not necessarily need to go far south to see swarms of insects. Take ants, for example. A single ant is a minute thing that you hardly notice whereas there can be as many as several bucketfuls of insects in a big anthill. In a large forest there may be many such anthills. So just try to guess how many ants there might be in a forest. Or, say, how many mosquitoes are in a marsh? Look at a meadow at the beginning of summer. There are lots of flowers there and on each flower honeybees, bumblebees, butterflies and flies are busy. There are many more of them than flowers. If you look more carefully, you will see that everywhere—in the forest, meadow, orchard, or kitchen garden—there are hundreds of insects. Usually, we do not notice, or pay attention to them. That is why we often say they are inconspicuous.

What is remarkable about insects is not only their great numbers, but also their variety. Look at a moth that has flown into the lamp light. It seems as if it is covered with delicate fur. Peeping out through this fur are round luminous eyes and six tenacious legs. Instead of a mouth there is something resembling a coil spring, and the feelers, also called antennae, look like narrow feathers. This insect is called the owlet moth. It is soft and fluffy like the owl, has big eyes and flies by night.

Migratory or Asiatic locust ▶

Butterfly

Fly

Beetle

The housefly, on the other hand, is quite different. It has a short body covered with bristly hairs and its head seems to consist of the eyes alone. In the mouth there is a long flexible sucking organ known as the proboscis, and all the six legs have pads or suckers at the end.

The hard-shelled beetle is quite unlike either the fly or the moth. It has six jointed legs and its mouth has sharp serrate jaws.

You would be surprised at the very odd creatures which can be found in an ordinary flowerpot. As soon as you water the flowers minute grey things, smaller than a dot in this book, start jumping on the moist soil. They are wingless, have segmented bodies, six very small legs and a curious forked tail. These creatures are called springtails. But they are still not the smallest among the insects.

There are also enormous insects. The largest among the beetles is the long-horn beetle. It is so big that it would hardly fit on your palm. And if the world's largest moth, the South-American Thysanie moth, spreads its wings, they would cover this page completely.

Although all these insects are different, they have something in common. Firstly, their bodies are divided into segments. Secondly...

Look at a spider. It swings on its intricately woven web. Its body and legs have joints. Or take another creature, a myriapod, named for its many, many legs. Here it is emerging from under a boulder and moving like a stream flowing on the ground. Both its body and legs consist of segments. Then both the spider and the myriapod are insects? To find this out let us count how many legs they have. Well, we discover that the spider has eight legs while the myriapod has so many we lose count. To be called an insect, however, a creature must have six legs—no more and no less. In other words, neither the spider nor the myriapod are insects.

In Ancient Greece the insect was called '*entomon*'. That is why the science that deals with insects is known as entomology and people who study them are referred to as entomologists. This book will tell you what entomologists have learned about insects.

Here is a grasshopper climbing up a blade of grass. It looks around and moves its numerous feelers. Its hind legs are long and clumsy and seem to be quite unfit for walking. But watch how the grasshopper behaves as soon as it senses danger. It carefully tucks its legs up to its body. The next instant they straighten like a spring and push the grasshopper forward. Another leap and it is out of reach. Just try to catch the jumper! This is why the grasshopper needs such long legs.

The legs of a praying mantis are quite different. Its hind legs

Caterpillar of a hawk moth, ladybird beetle, Maack's swallowtail butterfly, and longhorn beetle ▶

Mole cricket

Predaceous diving beetle

are not much longer than the middle ones, so it is clear that this insect is not a good hopper. The praying mantis is named for the posture it assumes, with forelimbs extended as though in prayer. The forelimbs look a bit strange: they are broad and armed with strong spines, and their upper joint is slightly curved and capable of closing like the blade of a penknife. The insect almost never uses these limbs for walking. What then does it need them for?

Here is a praying mantis resting motionless on a sprig. You can hardly tell what it is at first glance because the leaves are green and the insect is also green. A fly has landed close by. The sprig is trembling in the wind and the fly is totally unaware that one of the leaves is not simply swaying but moving slowly and carefully ever closer. The broad limb blades with sharp, serrated edges are open. They are very near now... Snap! And the praying mantis has its meal. So those legs are for hunting.

In the meantime quite different legs are busy working in the kitchen garden. They are short, flat, muscular, and shaped like shovels. And, indeed, they work like shovels, pushing the soil aside and digging an underground tunnel to get to the tastiest and juiciest radish. The owner of these legs, the mole cricket, is very fond of radishes. The mole cricket is big and brownish, slightly resembling a stout-bodied cricket. It lives underground and, therefore, cannot do without shovels, just like water bugs and beetles cannot do without oars. Their hind legs are flat like oars and are fringed with bristles along the edges, which makes for better rowing.

As for honeybees, their legs carry a set of instruments: combs for gathering pollen, baskets for carrying it, and combs for brushing it from their eyes.

In short, the legs of insects can tell you many interesting things about their owners.

Now let us have a look at how insects eat. A grasshopper gnawing a blade of grass does this not with teeth but with its jaws which are hard serrated plates. It has two pairs of these plates in addition to a forked lip and two pairs of antennae. It is surprising that the grasshopper does not get tangled in all this.

Besides grasshoppers, beetles, cockroaches and many other insects can gnaw and bite off. As for butterflies, they are unable to do this because their mouth is arranged quite differently.

Watch a butterfly which lands on the fluffy flower of a burdock to regale on the sweet nectar.

Praying mantis ▶

Stone bumblebee

Ground beetle

Swallowtail butterfly

The flower of a burdock is not simple. It consists of a multitude of thin tubes, each a flower in itself, and the nectar is hidden at their base. How can the butterfly reach it? Maybe it would make sense to chew the flower? But the butterfly has no intention of opening its mouth, particularly since it does not open, it uncoils. The mouth of a butterfly is long and thin, and called a proboscis. Usually, it is coiled up like a spring. But as soon as the butterfly comes down on a flower, the proboscis uncoils and slides down inside the flower tube reaching the nectar at the bottom.

The behaviour of a bumblebee is different. It is also attracted by nectar. But how can it reach the sweet juice? Bumblebees have no proboscis, they have jaws resembling those of beetles. But they have a long flexible tongue. The bumblebee dips its tongue into the pollen tube, reaches the nectar, and licks it. Honeybees gather nectar in the same manner.

The mouth of a fly is different still. A housefly running about the table sticks its soft fleshy-tipped proboscis out every now and then and sponges up what is left of food.

The mouth of a gadfly has a whole set of piercing and cutting instruments. The gadfly needs them because it feeds on the blood of man and animals. To be able to suck blood it has first to cut the skin.

A brightly coloured butterfly with pennant-like wing tips is flying over the meadow. This is a beautiful swallowtail called machaon. Compared to its small body its wings are huge. Every stroke of the wings pushes the machaon forward and it floats from flower to flower by starts, like an oarsman. Almost all butterflies which are active during the daytime, or diurnal butterflies, fly in this manner. Their flight is uneven because they flap their wings at rare intervals. In fact, every stroke can be observed. It is difficult for the butterflies to stay in the air against a strong wind. Instead they hide in the grass, otherwise the wind could carry them off and they might break their wings against bushes and trees.

The bumblebee, on the contrary, is not afraid of wind. It is robust, but has small wings which move with quick vibrations very much like a propeller. That is why they fill the air with buzzing sounds.

Flies also have small wings, but what good flyers they are! Look at the long-legged robber fly resting on the tip of a blade and looking around. Once it sees a wasp or some other fly passing by, the robber fly shoots into the air, like a spring, overtakes the prey and grasps it.

Not far from the robber fly a flower fly hovers like a copter. But as soon as you extend your hand to touch it, it disappears so quickly

Head of a long-horned meadow grasshopper ▶

Spurge moth

Dragonfly

May beetle

that you cannot tell where it went.

It would seem that insects with small wings are better flyers than those which have big wings, but not always. The dragonfly has long wings, yet it flies like a fighter plane, turning over, and diving in different directions in chase of a smaller insect.

Another example is hawk moths. When flying they flap their wings so agitatedly that all you can see is a blur of colour. By the way, these moths cannot only fly at great speed, but can also stop on the wing. They can hover over a flower and, uncoiling their proboscis, suck the sweet nectar, at the same time.

So we see it is those insects which flap their wings at greater speed that are better flyers. The size of the wings is not so important after all.

How many wings do insects have? If you look at the dragonfly, you will see that it has four wings. Honeybees and wasps also have two pairs of wings, but the front and back wings are attached by tiny hooklets and strike the air as one wing.

Here is a May beetle ready to fly. It slightly raises its rigid shining elytrons, also called wing covers, releasing its transparent wings from under them. Then it spreads them, flaps them, jumps and ... plops down. It just miscalculated its takeoff and struck a shoot. But, how many wings does the May beetle have? Two? No, it still has four because its elytrons, or wing covers, are wings though modified and somewhat hardened.

However, there are also two-winged insects. These are numerous flies and mosquitoes. Their hind wings have disappeared and become modified into organs known as balancers or halters. This, however, has not deprived flies of the ability to fly. One the contrary, they are the best flyers among the insects.

Countless wings are humming, buzzing, droning and rustling around us. They help insects find food, escape danger, and find shelter in bad weather. Were it not for wings, insects would have a much harder time of it.

The eyes of insects are truly amazing.

A fly resting on a flower sees everything that is going on around it. It looks up, down and back almost without turning its head. No wonder, because the eyes of a fly are round and take up half its head. So sneaking up to a fly is impossible.

The eyes of a dragonfly are even larger. They are two huge iridescent hemispheres looking in all directions at the same time. When a dragonfly is high above the ground it keeps a vigilant watch over

Butterfly on burdock ▶

Midge

Termite

Cicada

Whirligig beetle

every object in the air like the pilot of a fighter plane. If, for example, it notices a gadfly, it turns over on the wing, dives and grasps its prey.

Some insects have very strange eyes. Take the whirligig beetle, which lives mostly on the surface of the water. It has four eyes, not two. This is because each of its two eyes is divided into halves. The upper halves watch to see if something edible falls on the surface while the lower halves carefully watch what is going on under the water, alert for any danger.

Eyes of insects are very interesting. The eye of a dragonfly, for example, consists of a multitude of shiny knobs, called facets. Similar knobs are found in the eyes of beetles, butterflies and flies. Each knob is a small individual eye in itself. The more facets in the eye the better the vision. Such winged hunters as dragonflies, robber flies and wasps have a particularly large number of facets. Honeybees and many butterflies also have fine vision because to get nectar they have first to find suitable flowers.

There are insects whose eyes are very small. Caterpillars, for instance, have only a few tiny facets and so they have poor vision. Some insects cannot see at all; they are blind. In some southern lands yellowish-white ant-like insects called termites can be found. They live in underground nests and never come out. Naturally, these subterranean termites do not need eyes. In their place only dark spots remain.

Blind insects can also be found in caves where, for instance, eyeless beetles live.

But how do eyeless insects find their way in the dark and how do they find food? They do this through hearing, touch, or smell. A cave beetle walks on moist clay and slippery stones. It has long, threadlike feelers and its body is covered with delicate hairs by which the beetle is able to feel the slightest movements of the air. So if anything or anybody passes by, the beetle notices immediately. Its feelers are used for exploring the way through touch and smell.

But, how can one smell with anything but the nose? This is the same as being able to hear with your leg or taste with your heel.

Believe it or not, insects can do all this. Moreover, they can cry with their bellies, mark their way by scent and do many, many other things.

Various insects have the ability to smell with threadlike appendages, but, perhaps, butterflies are the best at perceiving odours. The feelers of the nocturnal Saturnia moth resemble complex antennae. In fact, they are antennae, but they receive smells, not radio waves. These

Fly ▶

Pear peacock butterfly

Long-horn beetle

Click beetle

moths are able to find another moth by scent at a distance of several miles.

Let us now watch ants. Some are hurrying along the path carrying food home. Others are racing in the opposite direction, climbing over stones and diving under blades of grass and branches. What if we try to help them by placing a piece of cardboard in their way? After all, cardboard is smooth and running on it would be easier. But look what happens. The ants do not step upon the cardboard. They crowd around it and behave very agitatedly. What's the matter? They have simply lost their way. One brave ant ventures on. However, it does not run in a straight line, but zigzags. It is followed by another ant, and then a third. But they all race about the cardboard as if they were blind. It takes them several minutes before they manage to find the shortest route. If we turn the cardboard, the confusion would start again. You see, ants mark their path by scent and find their way by smelling it.

Grasshoppers and crickets hear with their legs: their ears are in their front legs. Of course, they are quite unlike the ears of a man or a dog. Simply, part of the leg is hollow and inside there is a thin membrane which is sensitive to sound. Some nocturnal butterflies have ears in their bellies, at the base of the abdomen. When a butterfly like this flies in the dark, it listens for the squeak of a bat which is a night hunter. Once the butterfly detects the sound, it immediately dives down to find shelter in the grass.

Cicadas make sounds with their abdomens. Anyone who lives in the south or has been there is familiar with their monotonous, loud trills. In fact, almost the whole of their belly is an air sac with a thick membrane. By frequently clicking the membrane the cicada makes a long piercing sound.

Grasshoppers and crickets chirr by rubbing one wing against the toothlike ridge of the other wing. It is like rubbing your fingernail along the teeth of a comb.

If you carefully put a butterfly on a piece of cotton moistened with syrup, it will at once sense the sweetness with the tips of its legs and uncoil its proboscis to enjoy itself. Houseflies are also able to taste with their legs. This is very convenient. As soon as the fly settles on something, it knows right away whether this something is edible or not.

Have you ever thought of how insects grow? Why do beetles and butterflies always look like adults and why has no one seen a dragonfly as small as a mosquito or a nettle butterfly the size of a fly? After

Saturnia moth ▶

Adult long-horn beetle

Larva of a long-horn beetle

Pupa of a long-horn beetle

all, there are baby grasshoppers and baby bugs. Let us try to find this out.

No one noticed the small compact cluster of white eggs glued to an apple leaf which appeared one morning. Several days passed, the eggs darkened and in a week's time small ugly, prickly creatures began hatching from them. Each one had six clawed tenacious legs, a long, flexible belly, very small eyes and solid strong jaws. They were insects, there was no doubt about it, but what kind of insects? Beetles? No, they did not look like them. Neither were they butterflies nor flies, but something very strange. However, a person familiar with insects would immediately say: "It is a LARVA." What kind of a larva, whose larva? Let us wait and see.

Having emerged from the eggs, the larvae rested for a while and then crawled off in different directions. Not very far away some aphids were living on the same leaf. They were sitting together like friends and dipping their proboscises into the leaf, sucking its sap. The leaf had shrunk and twisted, and was obviously sick, but the aphids did not care. One of the prickly larvae noticed the aphids and ran towards them. To say 'hallo', you think? Nothing of the sort. The larva grabbed an aphid in a death grip and soon only the victim's skin remained. Then the glutton took another aphid in hand. Eventually, it became so fat that ins own skin burst. Had the larva died? No, not at all. It crawled out of the old skin and it turned out that under it was a new, more spaceous one. In other words, the larva had SHED ITS SKIN.

A month passed. The prickly worm was quite different. Over this period it had shed several skins, grown bigger and turned violet-grey with orange specks. One thing, however, remained unchanged—its voracious appetite. All the aphids on the nearest twig had been eaten up and the larva had moved to the next branch, then to another. At last it was full up. Now the larva squeezed out a black drop from its body, glueing itself to the leaf and, standing on its belly with its legs extended, it remained motionless as if asleep. Even its colour changed to a yellowy-brown. The larva had been transformed into a PUPA.

It stayed in this sleepy condition a week. Then the pupa started stirring and twitching until it burst. This time, however, a pale round-shaped small beetle emerged from the old skin instead of the larva. It dried off and grew darker. Its head and chest were black and its wing-cases, also known as elytra, were bright-red with black dots all over. It was not just any old beetle, but a real ladybird beetle! So that means the violet monster with orange specks was the larva of a ladybird.

This is how the acridian grows

Caterpillar of a tiger moth

Tiger moth

Very many insects grow this way. First a larva (in butterflies it is called a caterpillar) hatches from an egg. It feeds, grows, and then turns into a pupa. In the end either a young beetle, fly or butterfly hatches from it.

Such changes may sometimes be observed and it is very interesting to watch a brightly coloured, beautiful butterfly emerge from the uncomely pupa and spread its wings.

Far from all the insects, however, possess the ability to transform themselves. Bugs, praying mantises, aphids and grasshoppers are born from eggs looking very much like their parents. The only difference is that the young have no wings at first. As they grow they shed their skin, become larger, and, in the end, grow wings.

What do you think is more delicious: an oak log or a birch log? Or maybe a pine twig, acorns or prickly thistle heads? If one of these things were offered for your lunch, you would surely say 'No, thanks'. But what about insects?

Once a man bought a fine large table with strong solid legs. Many years had passed, when one day the man heard something scratching inside one of the table legs. Soon a hole appeared and from it emerged a beetle with antennae longer than their owner. It looked around wondering how it came to be there.

Some twenty years before a tree had been felled to make the table and all these years the larva of a long-horn beetle had been living in wood eating out a tunnel for itself. If the tree had not been felled, the larva would have grown much faster, in some three years, not longer.

Very many different larvae live inside trees and there is nothing more delicious for them than a piece of good sappy wood.

There is a beetle called the poplar leaf beetle. What does it feed on? The answer is obvious: it eats poplar leaves. The larvae of this beetle are feeding nearby. But they eat only the fleshy part of the leaf leaving its veins intact. In the end only the transparent netting remains of what used to be a leaf.

Here is another beetle working hard on the same poplar. Clutching at the edge of a leaf it is trying to roll it up. Hence the beetle's name—a leaf roller. The work is arduous and proceeds very slowly. It takes the beetle half a day to roll up just one leaf. But the rolled leaf is so narrow that it is impossible for the beetle to get inside. Then what does it need this for? The thing is that the beetle lays eggs into the roll. When the larvae hatch, they will have food and shelter.

Plants serve as homes for many insects and each type of insect has

Nun moth, its caterpillar, and bark beetle ▶

Poplar leaf beetle and its larva

Nut leaf roller

its favourite food. Some eat roots, others—leaves, still others—fruits or stems. In short, they feed on anything that grows. Some insects do almost no harm to plants, while others do a great deal of damage.

In the forests of Europe and the United States a very ordinary grey-brown butterfly, called the gypsy moth, can be found. At the end of summer it leaves a long clot of something in the bark of a tree trunk, close to the ground. The clot which looks as if it were covered by grey hairs, is a nest with several hundred eggs in it. Even bitter frosts cannot kill the baby caterpillars inside the eggs because it is warm enough under the snow blanket. With the coming of spring, the leaves unfold, and the caterpillars are there. They come out of their shells and gnaw the fresh foliage. As the caterpillars grow bigger, the foliage becomes more sparce. Then one day the leaves disappear altogether. Just imagine, it is summer and the weather is warm, but the trees have no leaves on them as in winter. There is no fruit and no seeds on these trees but only large caterpillars covered with long brittle hair. Even birds do not eat them because these hairs are poisonous. If such an invasion by gypsy moth caterpillars would continue unchecked for several years in succession, the forest would die. Fortunately, however, this does not usually happen.

Why not? After all, there are very many insects which cause damage to plants and each one is capable of laying a hundred, even a thousand eggs. One butterfly alone can produce half a bucket of caterpillars. Why then is such an army of gluttons unable to destroy all forests and orchards?

Because the grass and trees have not only enemies but also friends and protectors.

One protector is the European ground beetle. Scurrying about in the forests it climbs up trees and searches bushes, and if it runs against the caterpillar of a gypsy moth, it tears it apart in no time and eats it up, not bothered by the fact that the caterpillar is prickly and poisonous.

If you watch an anthill closely, you will see scores of ants hurrying towards it from all directions, carrying their finds. Some are bringing in a fly, others the leg of a dead grasshopper, but most of the victims are caterpillars. Those which are smaller are dragged whole, while the larger ones are carried in bits and pieces. Should caterpillars, beetle larvae or plant lice be born in great numbers, their enemies will immediately appear from everywhere. Some eat their prey themselves while others store it for their progeny, not for themselves.

This is exactly what the sand wasp or ammophila does. It has a long

Ground beetle

Wasp

Larva of an ant lion

string, sharp as a sword in its belly. The wasp uses it not only for defence, but also for hunting. When it sees a caterpillar, it rushes at its victim and stabs it with the poisonous sword. The caterpillar does not die, but is no longer able to move. The wasp grabs the caterpillar like a cat grabs a rat and carries it to its hole. There it lays an egg on the caterpillar. A larva will hatch that will eventually eat up its host.

There is one insect called the tachina fly which does not seek its prey at all. Unlike the sand wasp, it lays thousands of eggs on leaves in the hope that a caterpillar may eat one such leaf swallowing an egg which in fact is a tiny time bomb. In the end that caterpillar turns into a tachina fly, not a butterfly.

There are also insects which hunt the hunters. In the sandy soil under the roots of a fallen pine-tree you may sometimes come across very small, neatly shaped conical pits. An ant hurrying past such a pit has only to stumble and touch the edge then it slides down. Suddenly, two crooked jaws appear from the sand. Snap! and there is no ant. It is the larva of an ant lion that makes such traps. A small insect falling into the pit has no chance to escape. Even if it succeeds in dodging the terrible jaws and tries to run away, the larva resorts to another trick. It strikes the ground with its head and the flying grains of sand knock the victim down.

Insects have quite a few enemies—birds, animals, spiders and also insects themselves. So they have to protect themselves. But how?

Here is a beetle resting on a flower. Its black-and-red wing sheaths can easily be seen from a distance. You cannot fail to notice the beetle. Should an inexperienced little bird try to peck it, it will remember for the rest of its life that such beetles are inedible. Their blood is poisonous and that is why they are called blister beetles.

Wasps can also be seen from afar. Their colouration is a warning: Watch out! I may sting!

Syrphus flies, commonly called flower flies, have an abdomen banded with yellow, very much like wasps. But unlike wasps they have no sting and are unable to protect themselves. Why, then, do they need this colouration? The explanation is simple. A bird may catch one flower fly, a second and a third, but the fourth time it may mistake a wasp for a flower fly. From then on it never touches either wasps or flower flies. One never can tell which one of them has a sting and which has not.

When some butterflies see danger they spread their wings wide apart to show two big spots which look like the eyes of an owl or a cat, the two most fearful enemies of birds. There is no time to look more

Peacock butterfly and blister beetles ▶

Philanthus wasp

Scolia wasp

Kallima butterfly and measuring worm

closely. There is just time to flee before it is too late.

And what do those insects do which have nothing to frighten their enemies with? They have no choice but to disappear. Watch the caterpillar of a Geometridae moth creeping along a tree branch, now bending, now stretching, as if measuring the branch. Knock your finger against the wood and there suddenly is no caterpillar. It leans back, stretches out and becomes exactly like a dry twig.

Many beetles behave in a simpler way. They tuck their legs close to their bodies and fall on the ground. If you manage to find the beetle, you'll see it lying motionless pretending to be dead and inedible.

But, perhaps, it is the bombardier beetle which protects itself in the most interesting way. It fears no one. When touched, it sticks up its abdomen as if taking aim and fires a shot with a cracking sound. Of course, not a bullet, but a jet of stinging poisonous fluid. Any foe would retreat from such a shot.

Different insects live differently. Some exist singly, by themselves. These are solitary insects. Others can only live together as one family in a common nest which they build themselves. The family-minded insects are bees, bumblebees, termites, ants, and many kinds of wasps. They are called social insects. There may be as many ants in a good anthill as people in a big town, whereas the anthill itself is like a huge house with many rooms. Ants stay the night in this house, wait for the bad weather to pass, and sit out the winter. Here, too, young ants hatch. Somewhere in the middle of the anthill there is a chamber for the mother or queen ant whose sole function is to lay eggs. Other ants take them away and when the larvae appear, they feed, clean and protect them.

In areas with a temperate climate, such as the Soviet Union, the most common are red forest-dwelling ants which are fierce hunters. They drag home any insect they can overpower. You would think that when it sees a bunch of aphids it would immediately attack and destroy them. Nothing of the sort. It runs up to an aphid and drums on it with its feelers. The aphid behaves very strangely, as if expecting this. It raises up a little and releases a sweet drop. The ant licks it off and goes on to another, then a third, and so on. Each time the ant makes successive strokes as if milking the aphids. It is for this reason that the aphids are called ant cows. So if you notice a great number of ants on a tree branch, you can be sure that aphids are there too.

Honeybees on honeycomb ▶

Bumblebee

Among the social insects there are those which have been domesticated. These are the honeybees. They make their nests in special containers called hives. From a wax that the bees produce from their abdomen they build a honeycomb, a multitude of hexagonal (six-sided) cells attached to one another to form a rather thick plate. Into these cells the bees put the eggs laid by the queen bee. When a larva hatches from an egg, the bees feed it until a young bee emerges from the cell. This young bee is called a worker bee because it works all its life.

Young bees do not leave the hive; they are busy inside, looking after the queen bee, feeding the larvae, adding onto the honeycomb, and cleaning and protecting the hive. When the bee is three weeks old, it is no longer young, because bees do not live long. It is at this age that the bee comes out to gather pollen and nectar from flowers. The nectar and pollen are stored by the gatherers in an empty comb. The nectar dries a little and becomes honey that the bees feed on during winter. Usually so much honey is stored that the bee-keeper may take some and still leave quite enough for the bees.

Ant

Watching the bees, biologists have discovered that honeybees have their own "bee language". When the gatherer bee returns to the hive, it tells the other bees where there are many good flowers. However, it does not speak by making sounds, but by dancing, by whirling round the comb. Circular movements show that the flowers are closeby whereas figure-eight movements mean that the flowers are far away. By making other figures during the dance the bee tells the rest in which direction to fly.

When cold weather comes, the bees gather around their queen bee and warm one another the entire winter.

A friend of mine kept two small lemon trees at home. They grew all right and even blossomed, but gave no fruit. Once the trees were taken out on the balcony. The house was not far from a large park and bees quickly found the white flowers with narrow petals growing on the fifth floor. The flowers had a delicate smell and produced nice nectar. The hairy gatherers were busy on them all day long. In the autumn, bright yellow fruit appeared on the trees. My friend was very pleased and thanked the bees for doing such a good job.

"What do the bees have to do with it? They have not grown the lemons, have they?"

Honeybee

Bumblebee on clover ▶

Rose chafer

Oak leaf roller

Stag beetle

"No, but they pollinated the flowers and without this there would be no lemons," my friend explained.

Each flower has a long stalk in the middle called the pistil. It is surrounded by stamens whose tips are stuffed with pollen. Before the flower turns into a berry or fruit, it must be pollinated. In other words, the pollen from one flower must get to the pistil of another. Bees, butterflies and other insects are very helpful in spreading pollen. After ransacking the flower and sucking out the nectar, they come out powdered with pollen which they then take to other flowers. Were it not for the bees, bumblebees, flies and other pollinators, there would be no apples, pears, strawberries or cherries and no one would know what cucumbers or watermelons are like. Without insects these plants could just not grow.

All bright flowers that can be seen from afar are a kind of billboard devised by plants to attract insects. If, for example, we could understand what the violet flower of a clover would like to say, it would be something like this:

"Dear bumblebees,
Here you'll find the tastiest and freshest nectar.
Help yourselves! And don't forget to take some pollen along for my neighbour.
Other bees are asked not to bother because their proboscises are too short to reach my nectar."

That is why bumblebees fly to clover whereas other bees ignore it altogether.

Have you ever seen a herd of cows heading to pasture along a country road in the morning? The cows moo, nibble grass along the roadside, swish their tails to drive away horseflies, and, of course, leave their dung behind. By the evening, however, the dung has disappeared as if it had never been there. Where has it gone?

The explanation is simple. The dung was stolen by beetles.

One of them is the scarab, also called the dung beetle. It is a stout, round creature with a flat head and broad serrated forelegs. These legs work like shovels. The beetle uses them to rake dung and make a ball from it. Its flat, somewhat pointed head is very convenient for getting under the ball and moving it when it gets stuck. The beetle rolls its treasure to a nook and buries it in the ground. Then the beetle feasts until it has eaten the entire ball of dung.

There are many varieties of beetles which take away dung left by

Scarab beetles ▶

Pill beetle

Copris lunaris

Common dung beetle

cattle and wild animals. Some roll the dung away while others bury it right on the spot. But whichever way they do this, they all are very useful. Were it not for these beetles, country roads and pastures would be ankle-deep in dung.

However, it is not only dung that insects dispose of. Should a tree fall in the forest, little toilers immediately get to work. First bark beetles lay eggs. Their larvae eat the wood under the bark. Long-horn beetles gnaw into the wood making holes in it. In these tunnels mould appears and the tree begins to rot. Stag beetles, named for their long lower jaws which resemble the antlers of a stag, like to lay eggs in the rotten wood. These beetles are big and their larvae are enormous. Together they make more and more holes in the trunk of the dead tree. The trunk continually gets wet, and dries out until finally it rots away. At this point it is the ants' turn. Their weak jaws are unable to handle a healthy tree, but a rotten tree is just the thing for them. Ants gnaw at the wood and make their home in the rotten trunk. After some time the trunk disintegrates, leaving only ant-eaten debris. A little more time passes and what once was a tree is now dust. Thus the dead tree gives way to young shoots.

There are insects which dispose of dead animals and birds even by burying them. These insects are true sanitation workers. Just try to imagine what the Earth would be like if there were no scavenger insects.

Far from all the insects, however, may be regarded as our friends and helpers. You would hardly say this about gnats and mosquitoes which bite us, about houseflies that may carry disease or about clothes moths. Or about the gypsy moth which does great damage to forests and orchards or the locust which may bring famine to whole countries. Sometimes, insects which are usually regarded as harmless turn into pests.

This is what once happened in the steppes of Kazakhstan, a Soviet republic in Central Asia. The grey nocturnal moth used to live there. Its caterpillar, also grey with three stripes on its back, fed on the kernels of grain contained in the ears of steppe grasses. The moth was therefore known as the ear miner moth. The seeds of steppe grasses are tiny and not very nourishing so the population of moths and caterpillars used to be small. Then people ploughed the steppe and sowed wheat there. Caterpillars tasted its grain and liked it. It was good and nutritious, but most important, there was plenty for everyone. To make a long story short, the caterpillars feasted.

Colorado potato beetles ▶

Turnip moth

Pine sawfly

Tortoise beetle

Black beetle

Next year when the wheat ripened, swarms of grey moths were flying over the fields. After a little while grey caterpillars with three stripes on their back appeared on almost every ear. The harmless little moth had turned into a dangerous pest that proved to be very difficult to cope with.

A similar story happened with one beetle. These beetles lived in the foothills of the Rocky Mountains in Colorado, in the United States of America. They fed on the leaves of wild grass and did no harm to anyone. Then people planted potatoes and the beetle decided that potato leaves were the sweetest in the world. When they got through with them only stubs were left. And if there are no leaves there will be no potatoes. So the black-and-yellow striped beetle brought a lot of trouble. People do not like this insect and destroy it wherever they see it.

Hundreds of years ago, people had no idea how to fight pests. They did not even know what insects were. Many believed they were mysterious creatures like goblins and that they understood spoken language.

If some caterpillars had devastated a field, its owner had the right to file a complaint. The insects were tried in exactly the same way as criminals and the stern judge in a long black robe would pronounce the verdict:

"The worms are ordered to leave the field which does not belong to them and feed only on the waste ground where they will not be a nuisance to anyone."

For some reason, the caterpillars did not obey the ruling of the judge and nobody knew how to drive them away from the field.

Gradually, people learned that some insects could be done away with by sprinkling the leaves with ash or a tobacco brew, or by fumigating them with burning sulphur. Later, chemists invented various poisons which killed only insects. One such poison was particularly strong. Its name was no less impressive—DICHLORODIPHENYLTRICHLOROETHANE. This was almost impossible to pronounce and people began calling it simply DDT.

Hard times befell the insects. The poisonous powder was sprinkled over fields and forests from aeroplanes. Special machines sprayed the poisonous liquid on the orchards. The pests were destroyed and harvests grew bigger. It seemed that people had finally managed to get rid of the problem insects.

But then biologists discovered that not only pests, but also useful insects suffered, those which devoured pests, cleaned the forest and

Thrush poisoned by DDT ▶

Snout beetle

pollinated flowers. Huge numbers of honeybees had been killed by DDT!

The poisons were dangerous for other animals as well. Poisoned insects were eaten by birds which then died. Rains washed the poison into rivers making for less fish there. As far as the pests were concerned, strange things were happening.

One biologist was studying houseflies. DDT killed them all right. The poor things died for one year, two years, a decade. But then they refused to die. They could even live in a jar with DDT. It was one of the deadliest poisons, but the houseflies no longer cared. They would sit on it and wash themselves.

What had happened? The houseflies had simply got used to DDT. It was later discovered that not only the houseflies but also other pests might get accustomed to poisons. If this happened, fewer pests would die and those who survived would do greater damage. New means to fight the insects had to be found.

Wooly apple aphid

Colony of wooly apple aphids

Grafts of apple tree were once brought from America to Europe and no one noticed the stowaways—the wooly apple aphids—that came along. Several years passed and the aphids multiplied so much that they covered the branches and roots of apple trees with a thick greyish-brown layer. No ladybirds were able to overpower the pests and the apple trees were growing sickly. Why was this happening? After all in their home country these aphids did almost no harm. This was probably because they had some deadly enemy there which made it impossible for them to multiply uncontrollably. Biologists found this enemy. It was *Aphelinus mali*, a parasitic wasp so minute that it could easily get through the eye of a needle.

Then a parcel arrived from the United States containing several small boxes with these very wasps. Could it really be true that such tiny creatures would be able to save orchards? Gardeners were wondering. They let the wasps out in the orchard and waited to see what would happen.

A merciless invisible hunt started in the apple trees. A wasp would find an aphid and would prick its prey most skillfully with its needle-like ovipositor.

One prick and the wasp's egg was injected into the aphid. Then the wasp hurried to find another victim.

A month passed. Nothing had changed on the surface; the aphids were still resting on the branches forming a solid crust as before.

Aphelinus mali parasitic wasp

Aphelinus and wooly apple aphids ▶

Then one day a small round hole appeared on top of one aphid and from there something's feelers showed. Then came eyes, legs, and, finally, a new-born wasp emerged.

A similar scene was observed everywhere. Round holes appeared in the aphids and wasps crawled out. How did they get there? They hatched from the eggs which had been laid in the aphids. Now the aphids were hollow inside because they had been eaten by the wasp larvae. The trees that had been destined to die were now coming back to life.

Each pest has its enemies and people often make use of this. They set wasps, predatory flies, and ladybirds on aphids, and other parasitic wasps and tachina flies on caterpillars. When man enlists the six-legged helpers there is no need to sprinkle poison thus doing harm to nature. It is not so simple, however, to understand how to control pests and make useful insects help man. First it is necessary to study the life of insects, what they eat, their likes and dislikes. The tiny creatures cannot tell us about themselves.

Insects are studied by entomologists who observe them in orchards and forests, set out in search of them in mountains and deserts, each time discovering something new. It is an interesting, but difficult job. Sometimes years are needed to study just one fly or grasshopper. But the number of insects is enormous...

Entomologists have spent very many years discovering everything which is described in this book.

How many more things have yet to be discovered!

The number of insects are truly enormous and they differ greatly from one another. Those which live in Europe are unlike those which can be found in Africa or Australia. In the book that you've just read we told you about insects which are mainly common in the Soviet Union. In this vast country scientists have discovered some one hundred thousand species of insects many of which can also be found in other countries of Europe.

All in all more than a million species of insects are known to live in the world. Probably as many species have not yet been discovered and studied. So a great deal of work still lies ahead.

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